IMAGE SEGMENTATION USING SPLIT AND MERGE TECHNIC

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INTRODUCTION

Image segmentation in digital image processing is a technique by which pixels of an image sharing given same characteristics are grouped together.

Image segmentation is widely used in order to detect **objects** or **boundaries** in any given Image

The Split and merge Image technique is a **Region based** Image segmentation technique which passes in two phases:

The split Phase: consist of splitting the Image into **Homogeneous** regions using a **Quadtree data structure.**

The Merge Phase: consist of merging the resulting regions from the split phase based on a **homogeneity criterion** using **Region Adjacency Graph**

THE SPLITTING PHASE

The image **I** is recursively split into 4 equal regions using a **quadtree data structure** based on a homogeneity criteria which is determined by Two features the **variance (V)** and **mean(M)** of the region

Given a region **R** with N number of pixels, **r** representing rows and **c** representing columns, The variance **V** and the mean **M** of the region are given BY

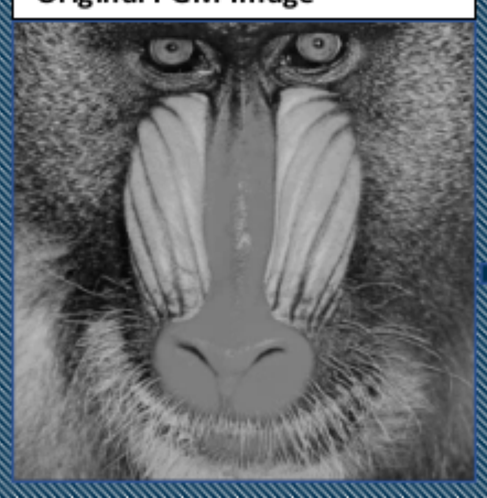
$$V^2 = \frac{1}{n} \sum_{(r,c) \in R} \left[I_{(r,c)} - M \right]^2$$

$$M = \frac{1}{n} \sum_{[r,c) \in R} I(r,c)$$

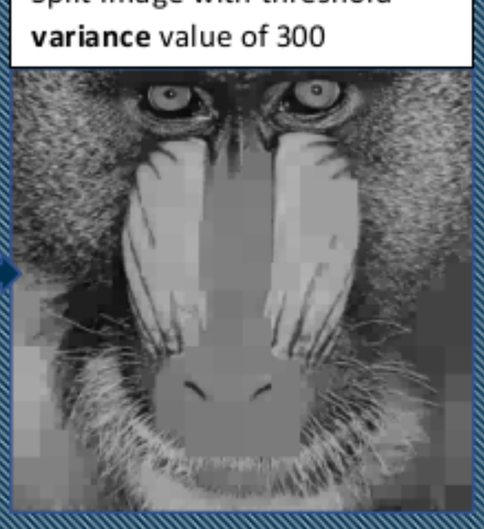
The splitting process consist of comparing the region's variance to a predetermined **threshold** value, if it fits the homogeneity criteria, we stop splitting and give all **pixels** in the region the **mean** value of the region it **if it doesn't meet the homogeneity criteria** we keep splitting till the region reaches its minimum value (Pixel)

Result of the splitting Phase

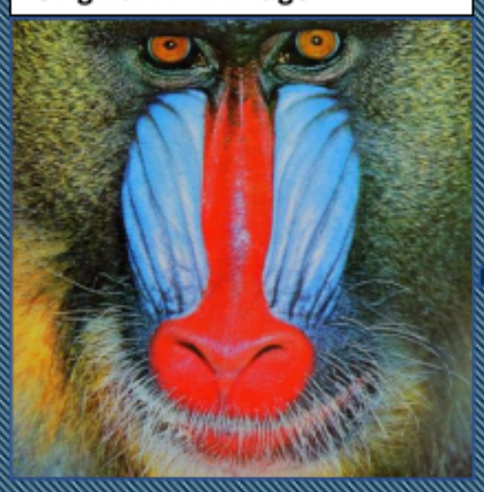
Original PGM Image



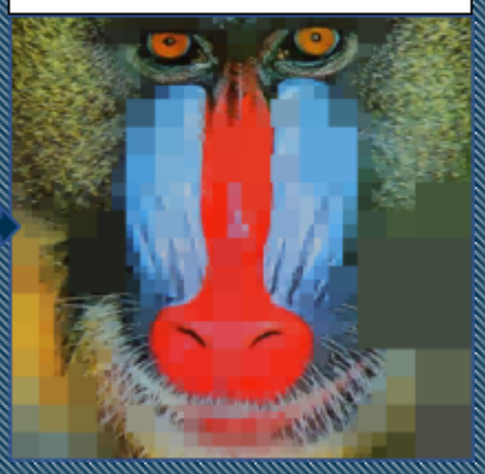
Split Image with threshold **variance** value of 300



Original PPM Image



Split Image with threshold **variance** value of 500

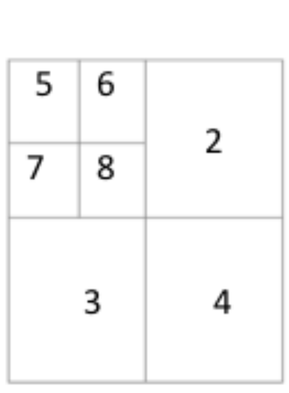


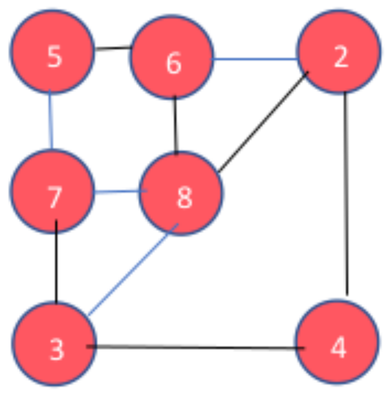
THE MERGING PHASE

After finishing the splitting phase the split image goes through a merging process through which **adjacent regions** with almost equal **mean** are merged together to form a larger region.

The merging process uses a **Region Adjacency graph(RAG)** that is created during the splitting process

An example below shows a **RAG g** that could result from an image **I**:





Result of the Merging Phase

Merge PPM Image

Merge PGM Image

"Split & Merge" is an **efficient** *method of segmentation since it combines the two operations of Split and Merge. But it is* **highly dependent** *to the efficient* **algorithms** *that we choose.*

References:

1- Scikit image documentation

2- Open Source Computer Vision documentation